

ON TRAUMATIC RUPTURES OF THE URETER, WITH
REPORT OF A CASE OF RUPTURED URETER
FOLLOWED BY NEPHRECTOMY
IN A CHILD.

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POSITION, mobility, and size combine to protect the ureter from injury, and it is well known that rupture of it is a lesion of the greatest rarity. Nevertheless there are a few cases on record which show that the ureter is not exempt from the possibility of rupture in abdominal injury without external wound, and that there are certain fairly uniform symptoms whereby correct diagnosis may be made. I propose in this paper to examine the cases which have been recorded, but shall, first of all, give an account of a case which was recently under my care, and in which it became necessary to remove the kidney on the affected side.

On September 24, 1892, Charles N., aged five years, was knocked down and run over by a light vehicle, the wheel of which was said to have passed over his abdomen. He was brought to St. Mary's Hospital, but there was no evidence of serious injury, and he was sent home. On the 26th, however, he was brought back and admitted because his parents had noticed that on three separate occasions there was blood in his urine. Once there had been a small clot passed at the close of micturition, and twice had blood in very small quantity been mixed with the urine. The child had been bruised in many places, but that of which he most complained was abdominal tenderness. There was no mark of abdominal contusion. As his evening temperature stood between 100° and 102° F., and as the tenderness seemed to be especially marked in the right iliac fossa, my colleagues, Mr. Silcock and Dr. Lees, held a consultation about him, for the site of the tenderness, and the suspicion of some swelling also, rather

pointed to trouble in the region of the appendix vermiciformis. Nothing very definite, however, was discovered. His bowels were cleared out by enema, and with good result, for the temperature fell to normal, and the abdominal tenderness disappeared. The urine was at this time in every respect normal, and it did not occur to any one that either kidney, ureter, or bladder had met with injury. He came under my own care on my return to the hospital, October 1, and during the next fortnight had a normal temperature, was free from pain, and was generally so well that I took his case as the text of a clinical lecture on intra-abdominal injuries without external wound, and as one in which the course of events had so far shown the propriety of abstaining from operation. On October 14, however, twenty days that is after the accident, the evening temperature had gone up to 100° F., and on the 17th to 103° F., while there was a marked return of abdominal tenderness. There was also decided swelling with dulness on percussion in the right iliac fossa, and this unquestionably showed a tendency to increase during the next few days. Abdominal tenderness and impaired movements in respiration were also more noticeable, and the temperature on the 23d, 24th, and 25th was as high as 103° F. The urine was normal in every respect, but no measurement of the daily quantity was made at that time.

Up to this point there was nothing in the history or symptoms, with the solitary exception of the transient haematuria, to lead to the suspicion of ruptured ureter; but inasmuch as the temperature continued high and the swelling to increase, with obviously greater abdominal tenderness and impaired respiratory movements, together with manifest failure in the child's general condition, it was resolved to explore the tumor by an opening through the abdominal wall. Of the swelling itself, it may here be said that it had certainly increased from below upward, that it was uniformly dull on percussion, occupied the right iliac fossa almost as far as the middle line, and that its position and characteristics were in nowise affected by change in the posture of the child. Associated with it there was undoubtedly some peritoneal effusion, which to some extent determined the exploration. Accordingly, on October 27, the abdomen was opened in the right linea semilunaris by a three-inch incision immediately over the swelling. Clear serous fluid escaped from the peritoneal cavity directly it was opened, and there bulged forward into the wound a soft fluctuant swelling the size of a large Jaffa orange. This was forthwith opened by an incision corresponding with that already made in the abdominal wall, every care being taken, by suture of the inner lip of the incision

to the parietal peritoneum, to prevent the escape of any of the fluid from the cyst into the peritoneal cavity. The peritoneal reflection could be felt a couple of inches external to the site of the opening, and it was manifest, therefore, that the fluid was entirely behind the serous membrane. The ascending colon lay to the inner side. The collected fluid measured forty ounces, and mixed with it were a few colorless clots of fibrin. The analysis of the fluid, and of a later specimen submitted to him, was made by Dr. Adler Wright, F.R.S., and is recorded below.¹

It was now for the first time possible to explore the cavity in which the fluid had been collected. The right kidney was seen to be of normal size, and apparently healthy in all respects both to sight and touch. So also it may be said of its pelvis, in which no opening whatever could be found. Attention was therefore directed to the ureter, but in the couple of inches at its upper end exposed to view no rent or other abnormality was visible. Below this point it was no longer in view, and I deemed it unnecessary and unadvisable to dissect it out as far as the bladder, having the hope that if the fluid came, as was suspected, from a rupture in the ureter lower down, the hole in it might be small, and that in the probable closure of the now empty cavity the collapsing walls might lead to obliteration of the ureteral wound. It was with the same object that a drainage-tube was inserted into the cavity before closure of the abdominal wound.

The child bore the operation well, and the temperature fell steadily after it. Daily measurement was now made of the urine passed from the bladder; the quantity very rarely exceeded six ounces, specific gravity 1025, acid, without albumen or blood, and there was little variation in the amount until after the nephrectomy in November. The wound continued aseptic and dry until the 31st, when the dressings were found saturated and of a distinctly urinous odor. It is no

¹Dr. Wright's report on the fluid submitted to him for examination: "The first sample (about a quart) contained so little uric acid that the precipitation and detection thereof led only to an uncertain result; at any rate, only minute quantities of uric acid were present. By the hypobromite test it yielded nitrogen equivalent to about 0.35 per cent. of urea, or from one-eighth to one-tenth the usual amount. This may have partly come from substances other than urea; at the most, the fluid did not contain more than about 10 per cent. of normal urine."

"The second sample contained much more uric acid, though less than a sample of ordinary healthy urine tested side by side. It yielded nitrogen equivalent to 1.35 per cent. of urea; samples of ordinary urine examined side by side giving 2.65 to 3.05 per cent. Presumably, therefore, the fluid contained half its bulk, or somewhat less, of normal urine."

wonder, therefore, that before very long there was clear indication of septicity in pus, mingled with the fluid discharge, and that the temperature again rose. Some of the fluid from the side was collected for examination, and proved to be unquestionably urine (see Dr. Wright's report); but, inasmuch as the kidney had been seen to be healthy and no orifice had been found in the ureter, it was thought advisable before proceeding to any further operation to distend the bladder and find if there was any leakage in its walls. Although the symptoms had never been those of rupture of the bladder, it seemed just possible that this might be the source of the urine flowing from the side, more especially as the quantity of water passed per urethram was so extremely small. This was accordingly done on November 6, and the bladder was found intact. No further sign of improvement was now observed; rather the child seemed to be failing day by day; there was free discharge of purulent urine from the wound, the temperature was high, 100° to 103° F., and there was much restlessness and complaint of abdominal pain. It was certain that the point of leakage showed no tendency to close, and removal of the right kidney alone remained as a means of dealing with the existing condition of things. Accordingly, on November 26, by an incision in the line of that originally made, the kidney was removed without much difficulty. The pelvis was distended and contained semi-purulent urine, while the kidney itself was enlarged to three times its natural size. Its surface was rough and granular, and here and there were visible foci of suppuration. It was, in fact, in a somewhat advanced condition of pyelonephritis. The pelvis and upper part of the ureter were both found entire. The contrast between the kidney now and the kidney when first exposed, on October 27, was most striking, and showed how rapid may be the effects induced by the combined influences of septicity and obstruction to outflow of urine.

Considering the septic state in which the operation had been undertaken, and that the wound had certainly been contaminated by the filthy stuff which was lying in the pelvis of the kidney, the immediate result of the nephrectomy was in every way satisfactory, and by December 3 the temperature was normal. The child also had rapidly begun to improve, and what is even of greater interest, the quantity of urine had begun immediately to increase, so that whereas up to the time of the removal of the kidney the amount passed from the bladder had been usually no more than from three to six ounces a day; it now rose to twelve ounces, and was afterwards rarely below, and frequently above, that quantity. Some little trouble subsequently arose from

pocketing of discharge in the cavity left after the nephrectomy, and on two occasions it was necessary to insert and pass a drainage-tube through to the loin. But when the child was discharged, on March 17, 1893, the wound had been soundly healed for some time; he was happy and well and free from pain, and passing by his single kidney a larger quantity of urine than when that kidney was sympathizing with its diseased fellow.

I have ventured to speak of this case as one of ruptured ureter, but inasmuch as the rupture was never seen, it is natural that some doubt may be felt as to the correctness of the diagnosis. It will be well, therefore, first of all to inquire if there be any evidence of ruptured ureter from post-mortem investigation. At least five cases are at our disposal for this purpose. In Vol. X of the *Transactions of the Pathological Society of London* there is that of Mr. Haviland, entitled, "Obliteration of a Ureter; Abscess-like Dilatation of the Calyces of the Kidney." We read that—

"The ureter was atrophied and impervious, and with the vessels was surrounded with a great quantity of fat. . . . Four or five years before his death he fell on his back from a height of twenty or thirty feet. . . . It is very probable that this accident caused this obliteration of the ureter, and that from this followed the disease of the kidney."

In Vol. XXIII (1872, p. 159) of the same *Transactions*, Dr. Pye-Smith records a case of "Stricture of the Ureter and Dilatation of the Kidney, apparently of Traumatic Origin."

Two years before his death, which was due to a large hydronephrotic tumor of one kidney, a man had been laid up for three days with blood in his urine, following a kick on his left side by a horse. At the necropsy the "ureter was found dilated for an inch and a half, when it suddenly became contracted, so as not to admit the smallest probe. A few lines farther on it again assumed its normal size. Here there was no calculus impacted, nor any sign of recent inflammation. Looking back at the history of the case," Dr. Pye-Smith remarks, "it appears pretty certain that the origin of the disease was traumatic. . . . And the ureter must have been injured, if not torn across, at this time." During the two years since the accident the canal had been gradually contracting, and traumatic stricture had been formed.

In Mr. Poland's well-known paper in Guy's Hospital Reports, "On Rupture of the Ureter" (Vol. XIV, 1868, p. 85), is the case of a pregnant woman who died six days after a very severe abdominal and spinal injury from having been crushed between a railway-carriage and the platform.

"The swollen parts about the right kidney were in a gelatinous condition, and smelt putrescent. . . . On examination it was found that the right ureter was torn quite across just below the pelvis of the kidney, so that it ended by a broken end in the middle of the above half-sloughing tissues."

Soller describes the case (*Lyon Médical*, 1880, T. XXXV, p. 333) of a man who nine years before his death had received a severe blow over the left renal region. The kidney was cystic and much adherent to surrounding structures, and was one-third larger than normal. The ureter presented a considerable dilatation with thinning of its tissues. This dilatation reached from its origin in the pelvis as far as the middle of its course, where it suddenly became contracted so as to admit only the head of a pin. At this level the surrounding tissues were indurated and showed chronic inflammation. All this was clearly the result of injury in which the ureter had participated.

More remarkable than any of these cases, and of greater value for our present purpose, is one recorded by the late Dr. S. Coull Mackenzie in his "Medico-Legal Experience in Calcutta,"¹ p. 98.

A cooly died twenty-four hours after having been jammed between two heavy trucks. There was no external mark of injury. "The whole of the peritoneum was highly inflamed and matted together, and was adherent to the outer coats of the small intestines by means of organized lymph. There were two small ruptures, each the size of a pea in the right ureter. The abdominal cavity contained two pints of urine mixed with blood. No bones were fractured. I expressed it as my opinion that the deceased died from peritonitis, following the extravasation of urine into the abdominal cavity through the ruptures of the right ureter."

But even without the evidence of these cases, I venture to claim for my own case that it tells the same tale. The accumu-

¹ Edinburgh: E. & S. Livingstone, 1891.

lated fluid behind the peritoneum was undoubtedly urine, which it is practically certain came neither from the bladder nor from the kidney itself or its pelvis, for each and all of these structures had been either tested or seen. The ureter alone remained as a possible source, by means of an opening in the tube.

The question of the possibility of rupture of the ureter may be considered also from an anatomical point of view. It may be said that until recent times the position of the ureter has not been thought of great moment; but since the removal of calculi lodged in it has become a recognized surgical procedure, it has become necessary to know something more definite and precise about it. If we turn to the paper of Dr. Cabot, in the *American Journal of the Medical Sciences*, for January, 1892, entitled, "Observations on the Anatomy and Surgery of the Ureter" (Vol. CIII, p. 43 *et seq.*), observations undertaken with the object of determining how best to reach the ureter in various parts of its course for the extraction of stone, we find certain facts which have a distinct bearing on the possibility of rupture. Thus he writes,—

"As the ureters approach the pelvis in the lower part of their course through the abdomen, the left ureter lies close to the spine, and in the angle between the body of the vertebra and the psoas muscle. On the right the ureter is somewhat farther separated from the spinal column by the interposition of the vena cava inferior."¹ And further he says, "There is a relation of the ureter to the peritoneum which I cannot find mentioned in any description of its anatomy, a knowledge of which will greatly simplify this search.¹ This is the fact that the ureter is adherent to the peritoneum as it is stripped up from the parts behind. . . . The ureter was bound to the under surface of the peritoneum by fibrous bands. . . . Further, an examination of a number of subjects leads me to believe that the relation of the ureter to that part of the peritoneum which becomes adherent to the spine is within a slight range of variation pretty constant, the ureter lying just outside the line of adhesion. So that if the surgeon has stripped up the peritoneum, and come to that point where

¹ This fact, however, was noted long ago by Sir Philip Crampton, in a paper "On Aneurism of the External Iliac Artery" (*Medico-Chirurgical Trans.*, Vol. XVI, p. 162), in which he says, "The ureter in its course to the bladder lay like a white tape across the artery, but in the process of separating the peritoneum it was raised from it with that membrane to which it remained attached."

it refuses to strip readily from the spinal column, he will find the ureter upon the stripped up peritoneum at a short distance outside of this point. On the left side the distance from the adherent point to the ureter is from one-half an inch to an inch, while on the right side it is somewhat greater, owing to the ureter being displaced to the outside by the interposition of the vena cava between it and the spine."

These investigations of Dr. Cabot rather suggest that there is a particular place where its peculiar attachments and surroundings render the ureter somewhat specially liable to injury at that place,—in fact, where, he says, it lies a short distance outside the spot where the peritoneum, to which it is firmly adherent, refuses to strip readily from the spinal column. It seems not unlikely that the lessened mobility of the ureter at this place may make it more difficult for it to escape from the effects of sudden violence applied to the abdominal wall. Fixed parts of the intestinal tube are more liable than freely movable parts to be ruptured or contused from external violence, and doubtless the same thing holds good of the ureter also. Tending in the same direction are the remarks of M. Tuffier in his paper in the *Archives Générales de Médecine*, 1889, Vol. XX, p. 356, on "Ruptures of the Kidney and Ureter." Of these latter he says that accidental ruptures occur very much in the same way as ruptures of the kidney.

"Le conduit," he writes, "se rompt au niveau de son attache au bassinet. J'admettrais volontiers qu'il vient s'écraser sur l'apophyse transverse de la première lombaire saillante à ce niveau, absolument par le même mécanisme que celui qui déchirait le rein dans les contusions. Toutefois quand j'ai essayé d'arracher l'uretère sur le cadavre, c'est à ce niveau que je l'ai vu se rompre. On pourrait donc penser que l'arrachement peut être la cause de cette rupture. Quoi qu'il en soit, cette rupture est généralement totale et s'accompagne de rétraction des deux bouts du conduit."

Whether, then, the ureter gives way by reason of lessened mobility, or because it is actually crushed between the external force and the spinal column, there seems to be no question that rupture at some point in its course, remote from its origin in

the pelvis of the kidney or its termination in the bladder, may ensue from violence applied to the abdominal wall.

We may, therefore, turn to a consideration of the indications of the injury and the various means of treatment at the disposal of the surgeon.

Taking them in the order of their publication, there are, exclusive of those which were both fatal, four cases besides my own from which conclusions may be drawn,—the case of Stanley, as far as I know the earliest on record, the case of Barker, the case of Godlee, and the case of Allingham. All of them confirm the remark of Stanley, who, contrasting rupture of the bladder with rupture of the ureter or pelvis of the kidney, wrote that¹ “the rupture of the ureter or pelvis of the kidney may present this remarkable feature when contrasted with the consequences of a rupture of the bladder; that whilst in cases of the latter injury symptoms immediately arise directly pointing to the organ which has suffered, in cases of the former kind (the lesion of the ureter or pelvis of the kidney), no symptoms may immediately occur leading to a suspicion of injury to any part of the urinary apparatus.” This fact will be best made obvious by a brief epitome of the main features of these four cases.

Mr. Stanley's was that of a boy, aged nine, who had received severe contusions of the lower part of the abdomen, followed by great pain, ecchymosis in the integuments around the pelvis, and extensive suppuration in the subcutaneous cellular tissue, from which several ounces of matter were discharged by puncture near the left sacro-iliac symphysis. There were all the general indications of a serious abdominal injury, but it was not until the lapse of six weeks that a swelling was observed on the right side of the belly, oblong in shape, reaching from the base of the chest to within a short distance of Poupart's ligament inward as far as the linea alba, and posteriorly into the lumbar region. Examination of the fluid withdrawn by puncture showed that it was accumulated urine.

Mr. Barker's² patient was a child, three years and eight months old, which had been run over by a hansom and bruised on the right side of the abdomen. There was, however, no sign of any very

¹ Medico-Chir. Trans., Vol. xxvii, p. 11, 1844.

² Lancet, 1885, Vol. i, p. 95.

serious injury, and after having been in the hospital for fifteen days it was discharged. After four days it was brought back, and then for the first time a fluctuant swelling was seen to fill the right side of the abdomen. Aspiration proved that the swelling was due to a collection of urine.

Mr. Godlee's¹ case was that of a girl, aged four, who had been run over by a cab the day before admission to the hospital. There were pain and tenderness with considerable bruising in the left inguinal and lumbar regions. These gradually diminished in the course of a fortnight, and there then appeared a certain amount of tension in the part where the bruise had been. "The indefinite swelling gradually gave place to a large, well-defined, elastic, and fluctuating tumor," which occupied very much the same position as that in Stanley's case, and which was aspirated twenty-three days after the receipt of the injury. "Five hundred and fifty cubic centimetres of turbid, slightly alkaline urine, containing 0.3 per cent. of urea," were evacuated.

In Mr. Allingham's² case, that of a lad sixteen years of age, the symptoms of abdominal injury from a severe blow were altogether more urgent from the first, and it was as early as the sixth day that he was called upon to explore a swelling which had formed on the left side of the abdomen.

In my own case, as the history has shown, it was not until all suspicion of any internal injury had faded that the abdominal indications of the lesion began to appear.

Why is it, it may be asked, that the collection of fluid behind the peritoneum after rupture of the ureter should be so long in being formed? Several explanations occur. If the rupture has been complete and the ends have curled up, as described by Tuffier, there must for a time, of course, be an obstacle to the escape of urine. Such obstacle may perchance lead to an actual diminution in the quantity of urine excreted, and a longer time elapses before such an amount has accumulated above the seat of rupture as to overcome the obstruction, and the urine begins to collect outside the tube. On the other hand, if the rupture has been partial and situated at one side of the tube, as in Coull Mackenzie's fatal case, some portion only of the urine may leak, while the remainder finds its natural route to the bladder. More-

¹ Clinical Society Transactions, Vol. xx, p. 219.

² British Medical Journal, Vol. I, 1891, p. 699.

over, in the case of injury to intestine, we know that perforation may be due to secondary sloughing rather than to primary rupture; and the slowness of the collection of urine behind the peritoneum may in like manner be due to the orifice having been formed by the sloughing of a severe bruise, rather than by immediate rupture at the time of the accident.

While then the one distinctive indication of what has happened seems in the ordinary rule to be postponed for some days or weeks, the surgeon has very little in the mean time to help him to a diagnosis directly after the injury. There may be the common indications of some abdominal injury, such as tenderness, pain, vomiting, and collapse, all of which may soon subside, and not one of which is of any special diagnostic import, but any blood there may chance to be in the urine may be so small in quantity as to be counted as of no moment, to be disbelieved, or entirely unobserved. Yet blood in the urine is a pretty certain indication of injury somewhere or other in the urinary organs, and a history of its presence, more especially if the amount has been small, ought to raise the suspicion of rupture of ureter after abdominal contusion. In injury to the kidney or the bladder the quantity is usually large and intermingled with the urine; while, as my own case has shown, after rupture of the ureter there may be no more than one or two minute clots. In Barker's case there were two or three small clots, but in Allingham's the urine was throughout free from blood, and we are told that in Godlee's case nothing had ever been noted amiss with the urine. An exception to this apparent rule, if indeed it was really one of ruptured ureter, is in the case of "Hydronephrosis of Traumatic Origin,"¹ recorded by Hicks. That case seems to me to have been almost certainly one of rupture of the ureter from a severe kick by a horse on the lower part of the abdomen of a boy aged twelve, and it is stated that the next day there was much blood from the bladder. However that may have been, the size of the ureter renders it unlikely that there can be any considerable quantity of blood, and when, as in Hicks's case, we read of much having been passed, the presumption is that the pelvis of the kidney may have been damaged at the same time. It comes,

¹ Medical Record, 1880, p. 424.

therefore, to this, that soon after the injury there may be a small amount of blood in the urine, and that signs of the collection of urine behind the peritoneum may not show themselves for several days. Diagnosis could hardly, therefore, be more difficult or uncertain, and the surgeon may have no more than a suspicion of what has occurred. The character of the urine may, however, be some help to him. In one or other of various ways it is probable that the site of injury to the ureter is also the site of some obstruction to the passage of urine along it. The effect must soon be felt by the kidney, which has thus to work against pressure, and apart from the fact that some of the urine excreted by it never reaches the bladder, the daily quantity is in all probability below the average. Great also is the reduction in the amount of urea, whether we examine the fluid withdrawn from the cyst or in that which is collected from an opening in the loin. This was strikingly exemplified in all three cases of Godlee, Barker, and my own. The record of Mr. Barker's case is indeed especially valuable for the prolonged series of observations on the urine, observations which revealed a vast difference in the percentage of urea in the urine from the two kidneys. Furthermore, the persistent irritation of the kidney on the affected side may tell upon the kidney on the sound side, so that it also excretes less urine than is normal. Look at the history of my own case for an example.

Let us now consider the various methods at the disposal of the surgeon for dealing with this serious injury.

First of all, and to be commended for its simplicity, but for its simplicity alone, is that of simple puncture for the evacuation of the fluid, as was originally done by Stanley.

He tells us that at the end of the sixth week, supposing the swelling to be an abscess,¹ he made a puncture with a lancet so that a little clear yellow fluid escaped, and that three weeks afterwards, the abdominal swelling having again become tense, he let out with a trocar, inserted midway between the last rib and the crest of the ileum, fifty-one ounces of the same kind of fluid as before. On four successive occasions, at intervals of eleven days, sixteen days, three months, and

¹ Here it is interesting to note that in none of the cases did suppuration occur until after the admission of air to the cavity.

six weeks it was needful, by reason of reaccumulation of the fluid, to use the trocar, and then after the last evacuation we read, "From this period the swelling continued without increase or obvious diminution; it still extended from the linea alba into the right lumbar region, and as any further interference by operation or otherwise was now considered inexpedient, I discharged the boy from the hospital nine months after the occurrence of the accident. At several subsequent periods I have seen him in good health, with the abdominal swelling still distinct, but, as we have thought, slowly diminishing and with less evident fluctuation."

It would have been of much interest to know what ultimately became of this boy, and whether there was subsequent disease or atrophy of the kidney. It is enough, however, for our present purpose to recognize that simple puncture by trocar and evacuation of the cyst may be insufficient as a means of cure. Nor is the method likely to be adopted in these days of abdominal exploration, and aversion from plunging trocars into abdominal cavities. Hicks, however, met with more success, for after three aspirations the quantity of urine from the bladder increased, and the boy got gradually well.

More adequate drainage of the cyst-cavity is obviously necessary. This it was that I endeavored to obtain in my own case, and was obtained with such signal success by Mr. Allingham in his. Having made an incision in the left linea semilunaris he opened the peritoneum and saw, on lifting the descending colon, a large sausage-shaped tumor, covered with peritoneum, extending from the kidney right down to the pelvis, exactly in the course of the ureter. It was very tense and the pelvis of the kidney was not distended. Suspecting what the swelling was, he proceeded, with most excellent judgment, to open the tumor by puncture from the loin and let out more than a pint of turbid urine. He found the cavity smooth and thought he felt the calyces of the kidney, while downward it went beyond the reach of the finger towards the bladder. The front wound healed at once, and the drainage-tube was removed from the loin on the sixth day, and in less than a month the boy was sent out well. On the assumption that this case of Mr. Allingham's was one of ruptured ureter,—and I do not think there can be much doubt

about it,—one must believe that in the free drainage and by gradual contraction of the cavity, the orifice in the ureter was sealed. It is of extreme interest to note that in his case, as in my own, the quantity of urine increased immediately after the operation and rose from fourteen ounces to twenty-eight, forty-four and fifty-four when measured at intervals in the course of the next ten days; not alone, I should imagine, because the urine from the kidney on the side of the rupture was now able to get into the bladder, but partly from this cause and partly from an actual increase in the quantity excreted by both the glands. The good result in Mr. Allingham's plan of treatment may, of course, have been in great measure due to the hole in the ureter having been very small, and in this hope it would be well to try his plan in future cases, although there could not be much promise of success when the ureter had been torn completely across, and the ends had retracted in the manner already described. Drainage behind must be more efficacious than drainage in front, and had my case been drained from the loin it is possible that the kidney might have been saved.

Failure of either of these methods of treatment leaves nephrectomy as a last resource, unless the surgeon should prefer to abstain from further treatment in the hope that the collection of fluid may come to an end, and the patient recover from the injury. I doubt very much whether in such circumstances there can be a real cure, for the probability is that, even though septicity be avoided, the kidney will become atrophied. Thus in the case brought before the Clinical Society¹ by Mr. Croft, in which he believed that obstruction of the excretory tube by adhesive inflammation rather than disturbance of the excretory organ, was the cause of the repeated collection of urine in the loin after an injury to the pelvis of the kidney, he says, "I imagine that the cure has come about by the atrophy of the left kidney, and the obliteration of the cavity." Such also, in all probability, was the end of Stanley's case, but it cannot, of course, be regarded as "cure" in any proper sense of the term.

There always remains the risk of the cavity becoming septic, when the condition of things is completely changed. The three

¹ Vol. XIV, p. 107.

cases, Godlee's, Barker's, and my own, all tell the same tale. Thus of Mr. Godlee's case we read that the tumor having rapidly refilled after aspiration, he proceeded a month after the accident to lay the cyst open and insert a drainage-tube. "For three weeks the patient was quite comfortable, except for the copious leakage of urine from the wound, which showed no sign of diminution; the tube had been removed and the cavity and the sinus had both very much contracted. Then began the first of a series of pyrexial attacks, no doubt due to some accumulation of pus and urine in the deeper parts of the wound. . . . In these the temperature often rose to 103° or 104° F., and the child was becoming pale, thin, and pasty-looking. The reinsertion of a tube had no effect in stopping these attacks. . . . I accordingly thought it best to remove the kidney through a crucial incision in the loin." The operation was extremely difficult, for the organ was embedded in dense fibrous tissue, and he feared that the upper end of the ureter was left behind and was the cause of the non-closure of the sinus, which continued to discharge a little pus. The history of my own case has shown very much the same course of events, while a most perfect demonstration was given to us of the combined effects of septicity and obstruction upon the kidney. When first seen it was in every respect healthy; when seen at the time of the nephrectomy it was enlarged and inflamed, and pus in it here and there, and its pelvis had practically become an abscess cavity.

So, also, Mr. Barker found it necessary to remove the kidney a month after free drainage had been established, and rather more than three months after the receipt of the injury.

In all these cases of nephrectomy the operation was borne well, and the remaining healthy kidney rapidly took up the work of both, and as my own case showed, the quantity of urine forthwith increased. Herein, indeed, lies the necessity of removing the diseased and pus-inoculated kidney on the affected side, that when it has become inflamed by reason of septic extension from the seat of the exploratory wound there is a grave risk that the kidney on the uninjured side may presently share in the morbid process. In his masterly paper, "On Disturbances of Sensation with especial Reference to the Pain of Visceral Disease" (*Brain*,

Vol. LXI), Dr. Head points out that so long as the organism is perfectly healthy disturbances in the activity of an organ produce pain and tenderness over certain definite areas only; but that when the pain has remained localized for a considerable time, the condition of the central nervous system becomes profoundly altered. And he proceeds, "When one testicle is affected, the tenderness also tends to be bilateral, and the same applies to the kidneys, especially if the disease is a long and wearing one. Thus there is a great tendency for both pain and tenderness to spread to the opposite side at the same spinal level." Here we have an explanation of the long-known fact that serious disturbance in the secretory gland of one side may profoundly affect that on the other, even to complete suppression of urine. The sooner, therefore, that nephrectomy is performed in these conditions of septic disturbance after rupture of the ureter the better is the prospect of success from the operation itself, and better also that of the patient's future health, dependent as it must more than ever be on healthy renal function.

It ought not to be regarded as a thing of light moment to sacrifice a kidney, and the surgeon should therefore give a fair trial to aspiration of the cavity or to free drainage, keeping the parts aseptic if he can.

The question of treatment, however, cannot be closed without a consideration of the possibility of suture of the ureter and the prevention thereby of all the troubles which these various cases suffered. It occurred to me at the time when I first laid the cyst open, but in the portion of it visible the ureter was intact, and as it coursed away from the region of the kidney it became altogether lost to view, and I did not deem it advisable to follow it. Cabot remarks in his paper that it is "extremely hard to find the lax tube." And if hard on the cadaver, it must be infinitely harder on the living subject. The ureter, as we know, has from time to time been sutured with success, in some cases to close the lateral incision made into it for the dislodgement of calculus, in others because of injury or division in the course of uterine operations. It is one thing, however, to find and expose the ureter in these conditions, and quite another thing when there is no fixed calculus to mark its position, or it has not been

brought into view. Nevertheless, the success which has attended ureteral suture, not only in the simple process of closing an incision made for the extraction of a calculus, as in the case reported by Arbuthnot Lane,¹ but also in the more complicated anastomosis, after the manner of Van Hook, related by Dr. Howard A. Kelly in the January number of this journal, shows that it might be well for the surgeon to try and restore the continuity of the tube, should, haply, the degree of injury it has sustained admit of this procedure.

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¹ Lancet, 1890, Vol. II, p. 967.